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(54) **ROASTING APPARATUS AND CONTROLLING METHOD THEREOF**

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H05B 1/02 (2006.01)

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CPC *A23N 12/125* (2013.01); *H05B 1/0269* (2013.01)

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See application file for complete search history.

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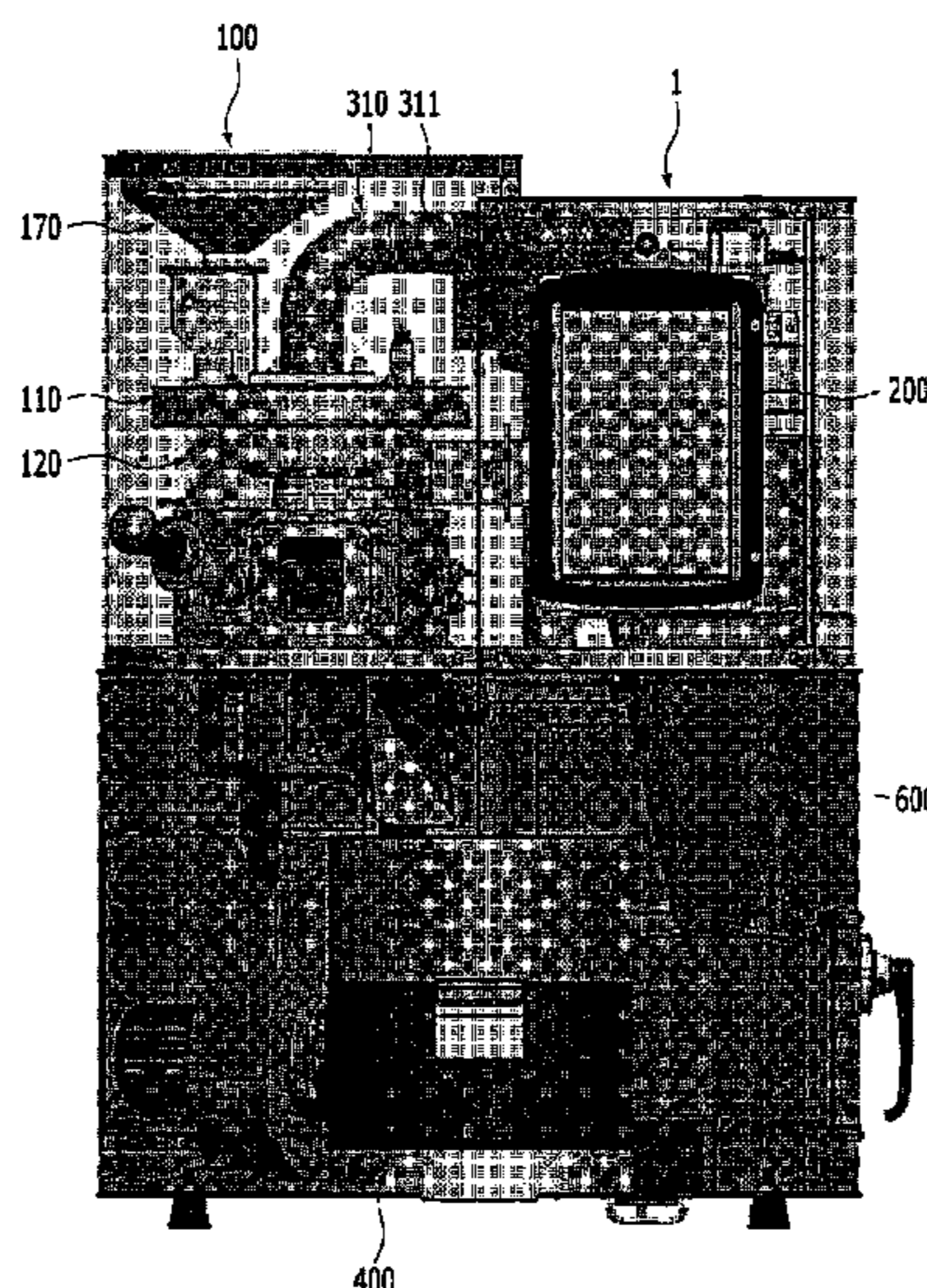
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(57) **ABSTRACT**

The present disclosure relates to a roasting apparatus and a method of controlling the roasting apparatus, and more particularly, to a roasting apparatus for roasting objects while stirring the objects in a roasting chamber, and a method of controlling the roasting apparatus. An roasting apparatus for heating objects according to the present disclosure includes a roasting chamber part which includes: a cylindrical roasting chamber that extends in a vertical direction and has an internal space in which the objects are stirred; and a rotary stirring part that rotates to stir the objects received in the roasting chamber and rotates about a stirring axis defined in the vertical direction. The roasting apparatus further includes heat source parts which supply heat to the roasting chamber part.

20 Claims, 10 Drawing Sheets



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FIG. 1

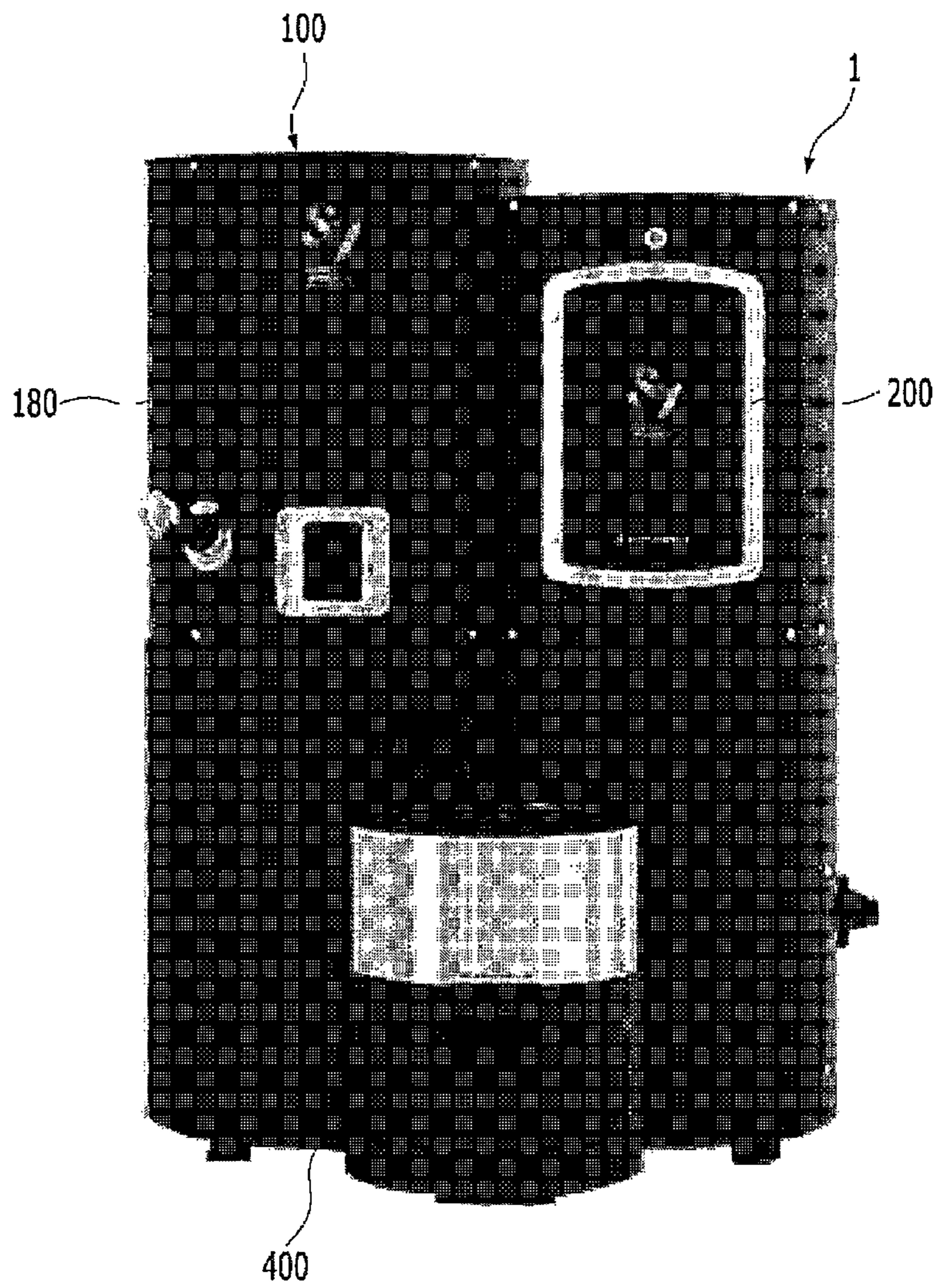


FIG. 2

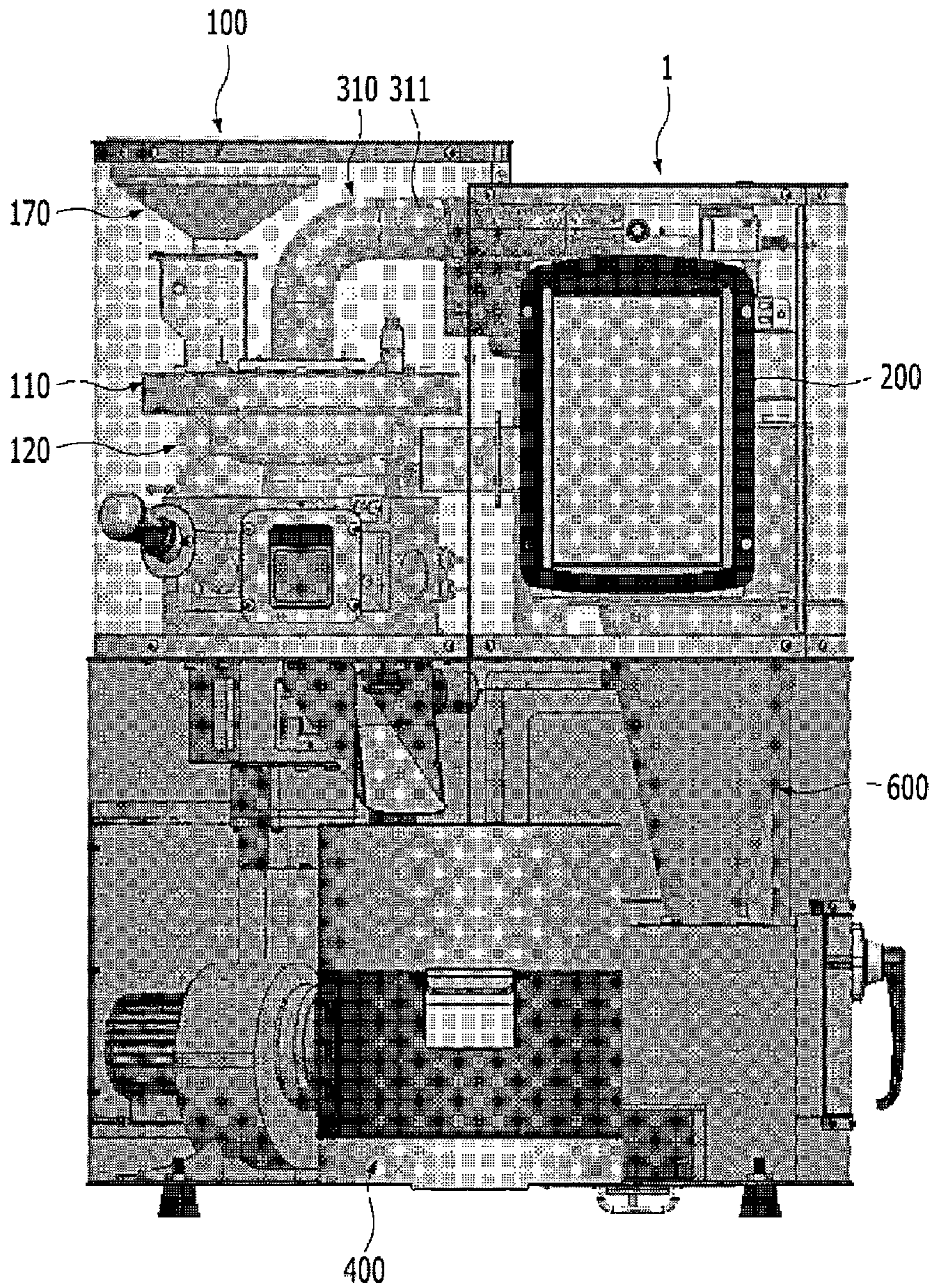


FIG. 3

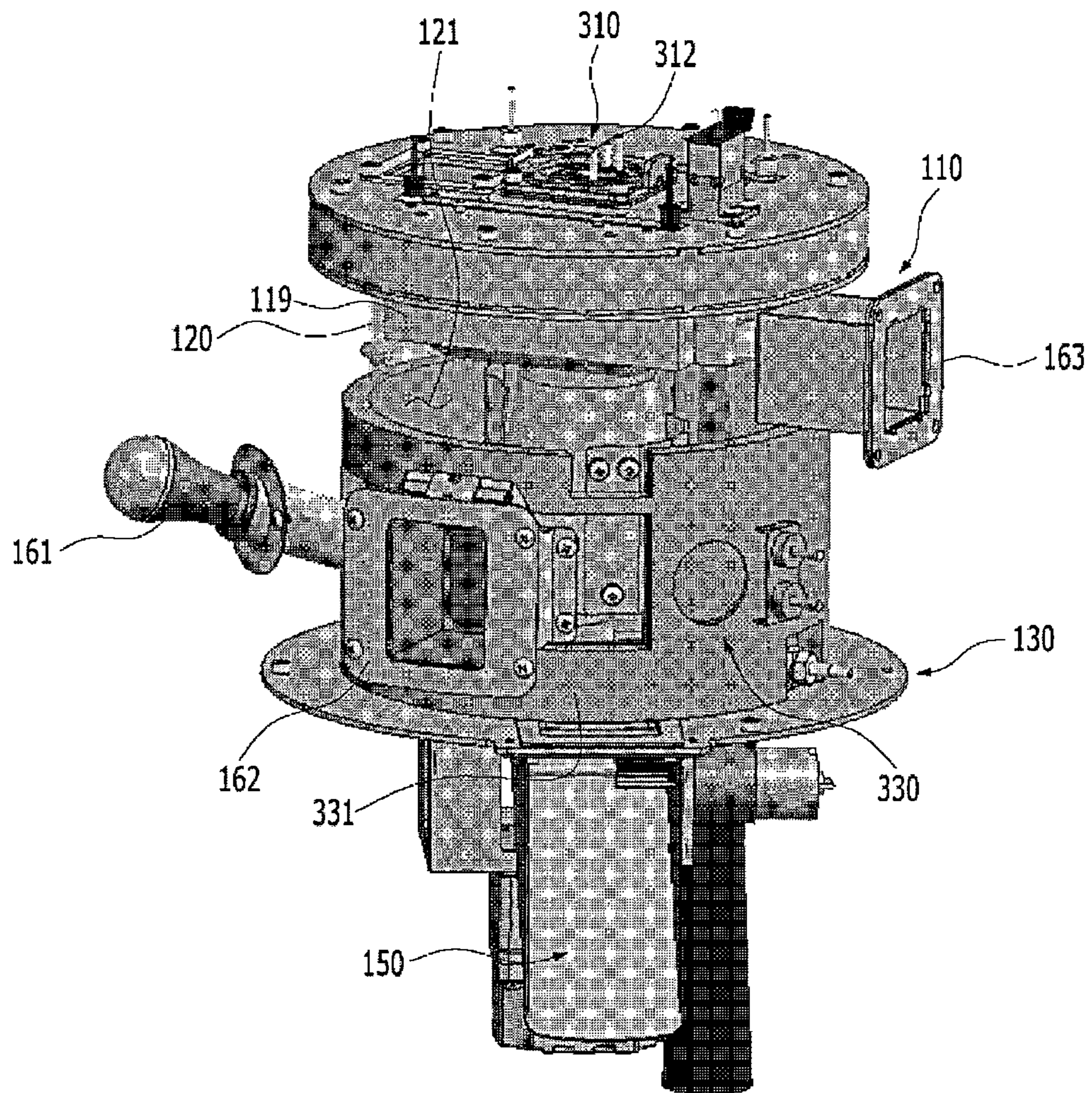


FIG. 4

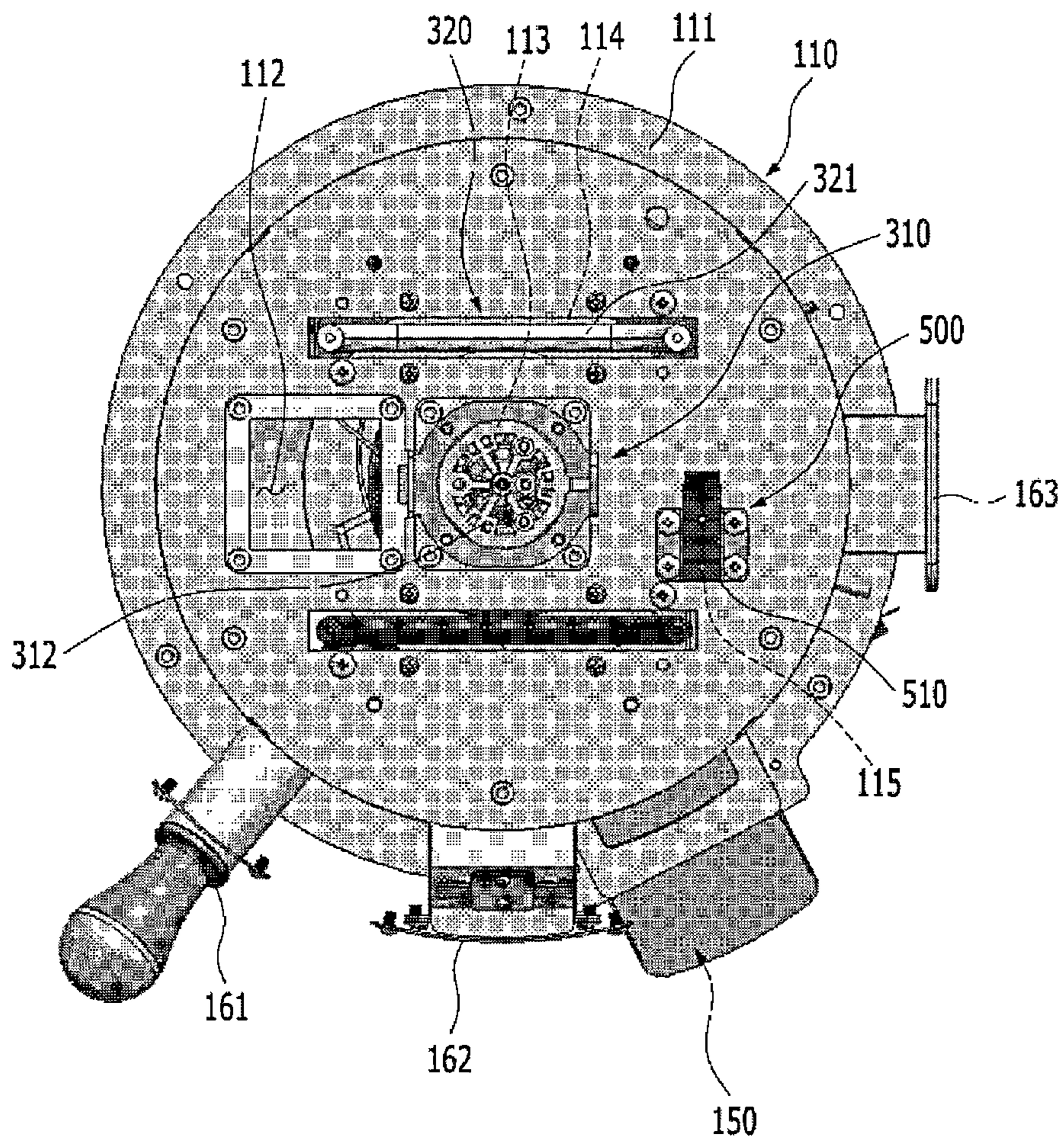


FIG. 5

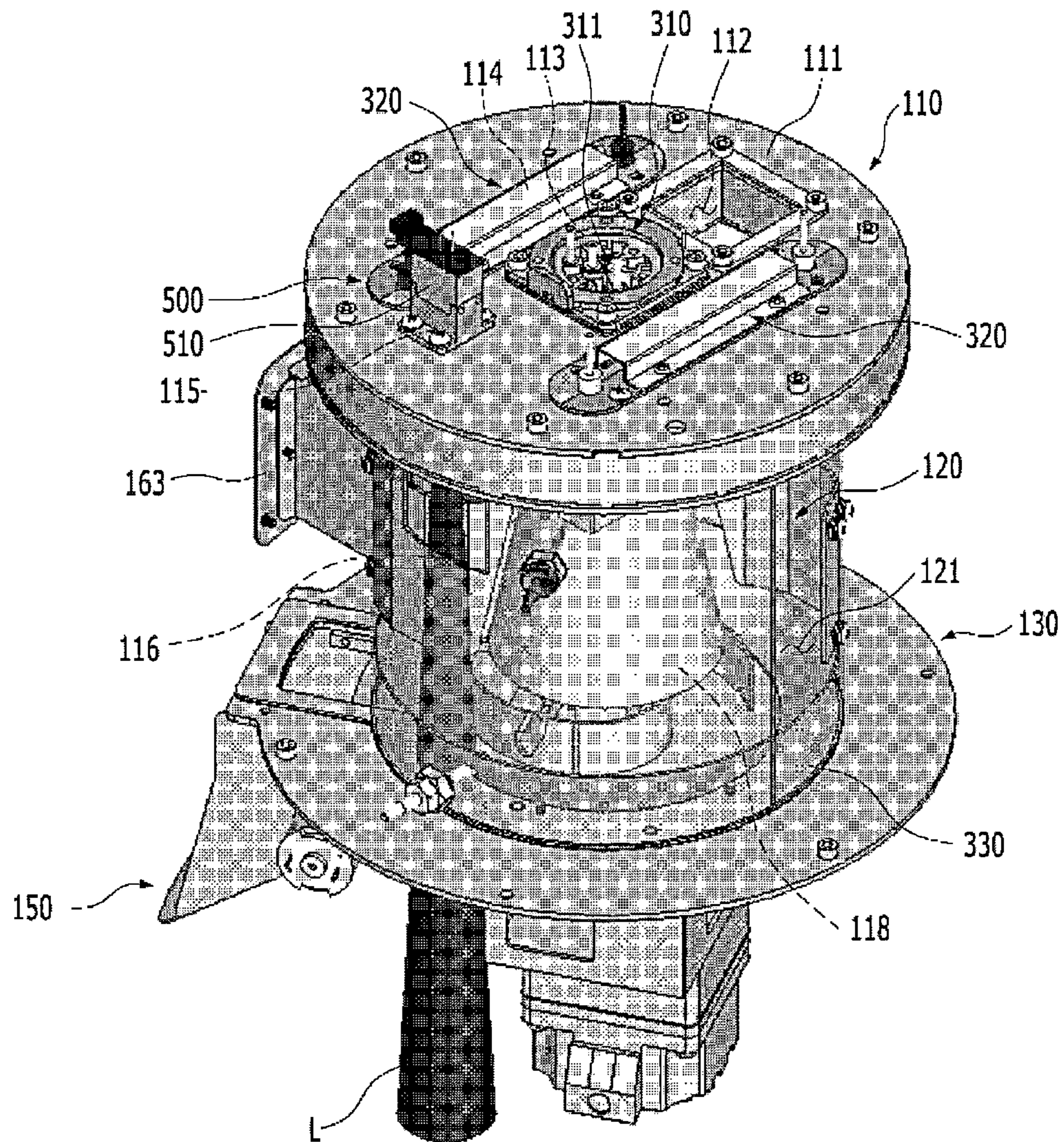


FIG. 6

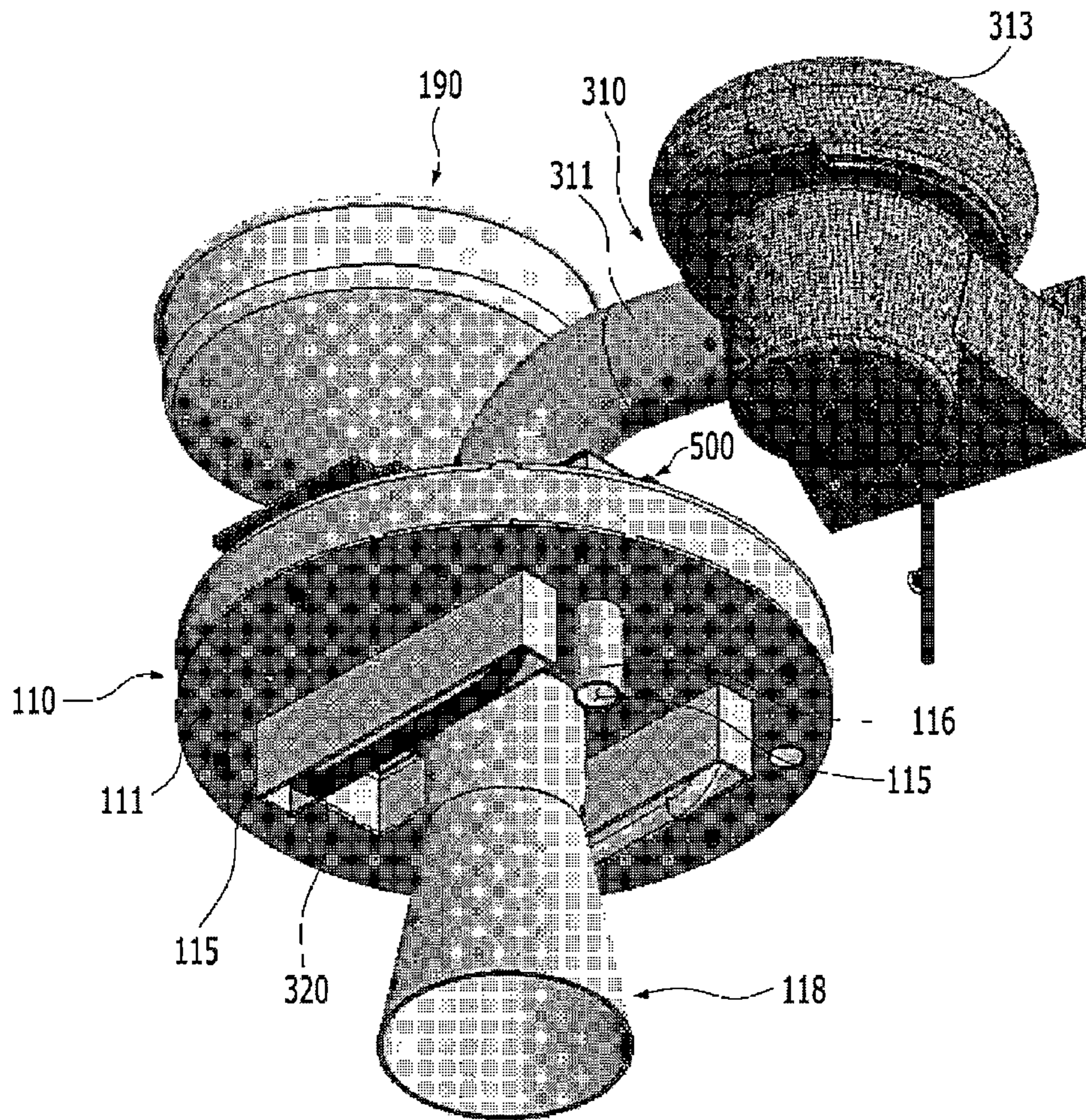


FIG. 7

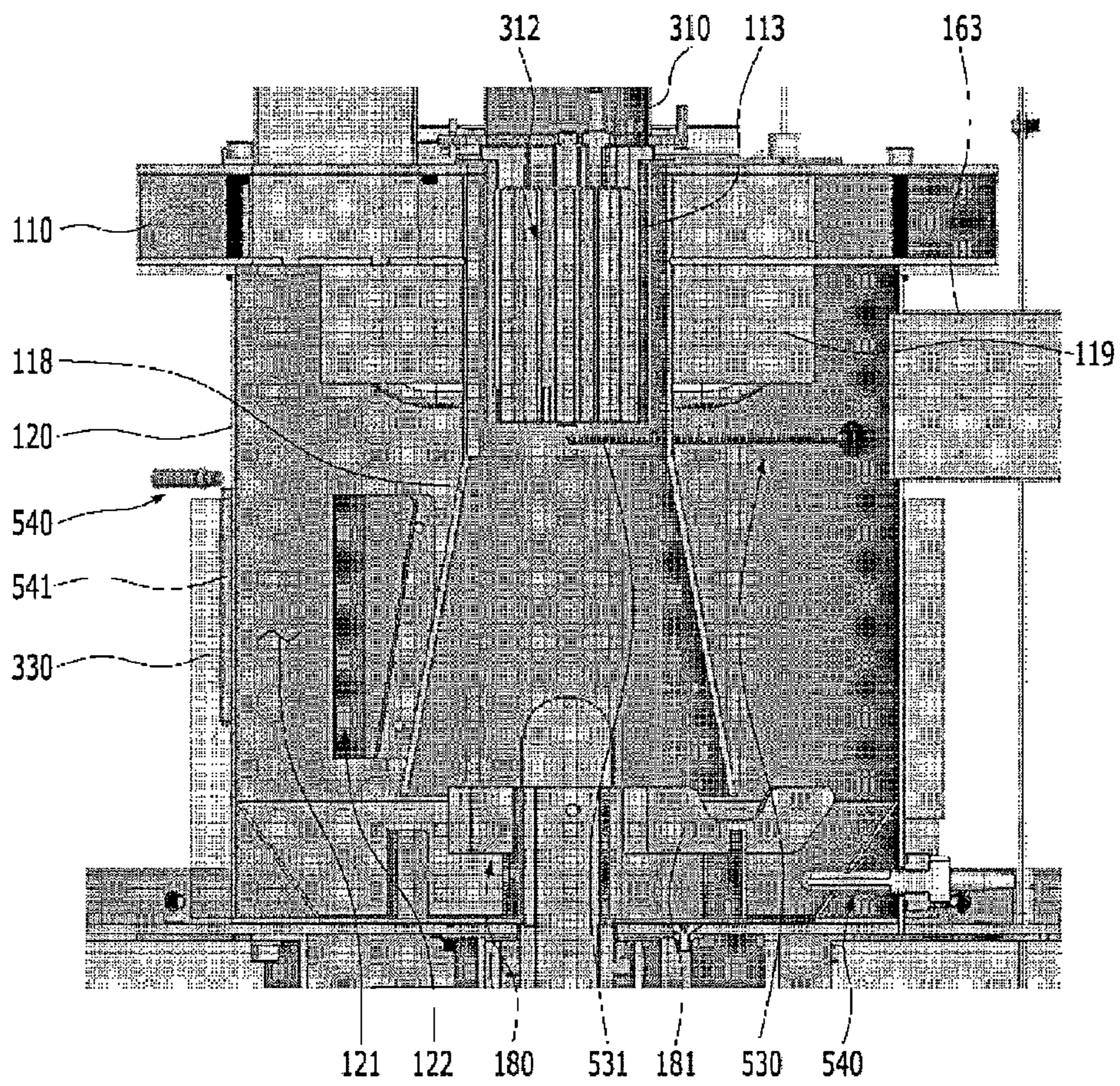


FIG. 8

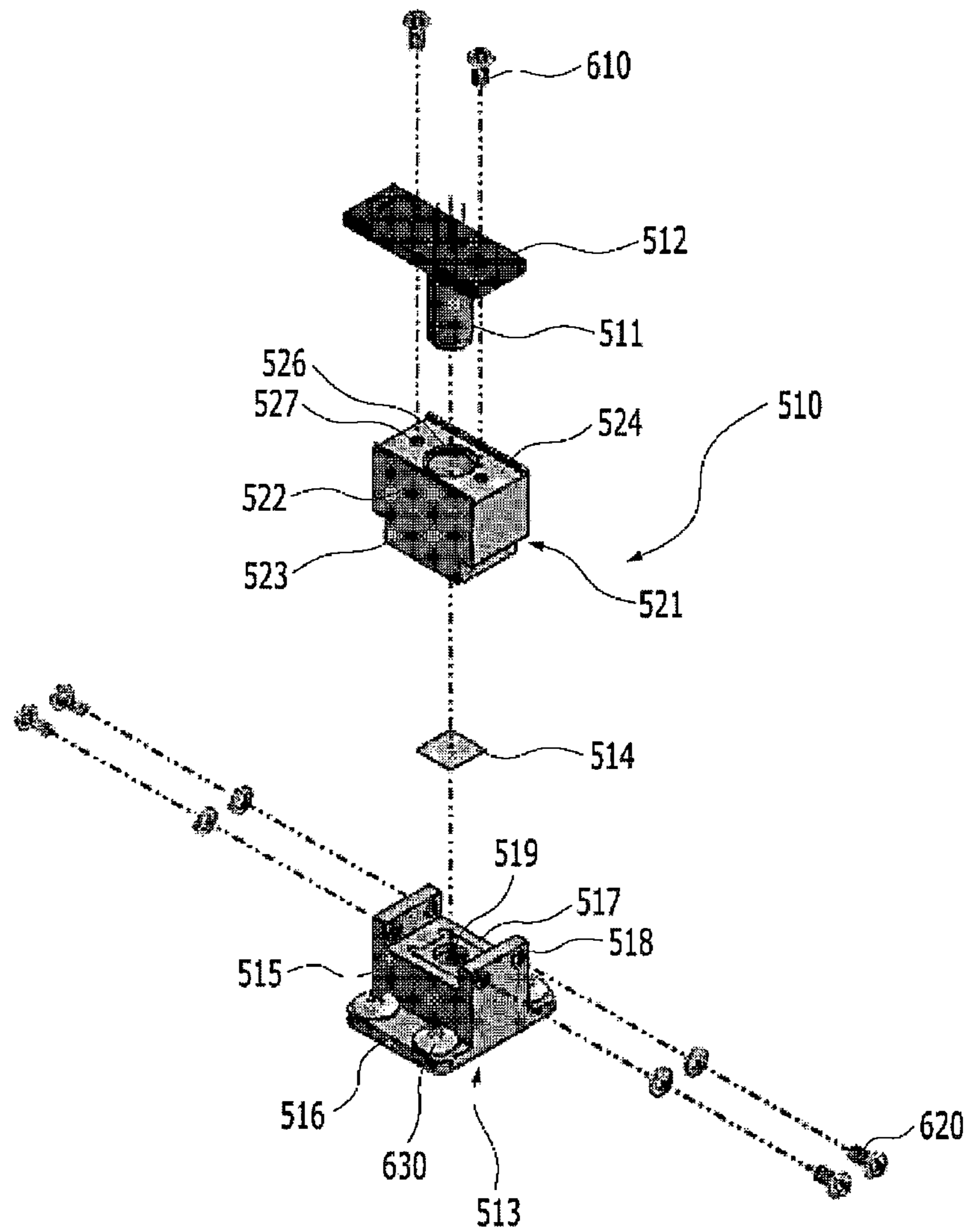


FIG. 9

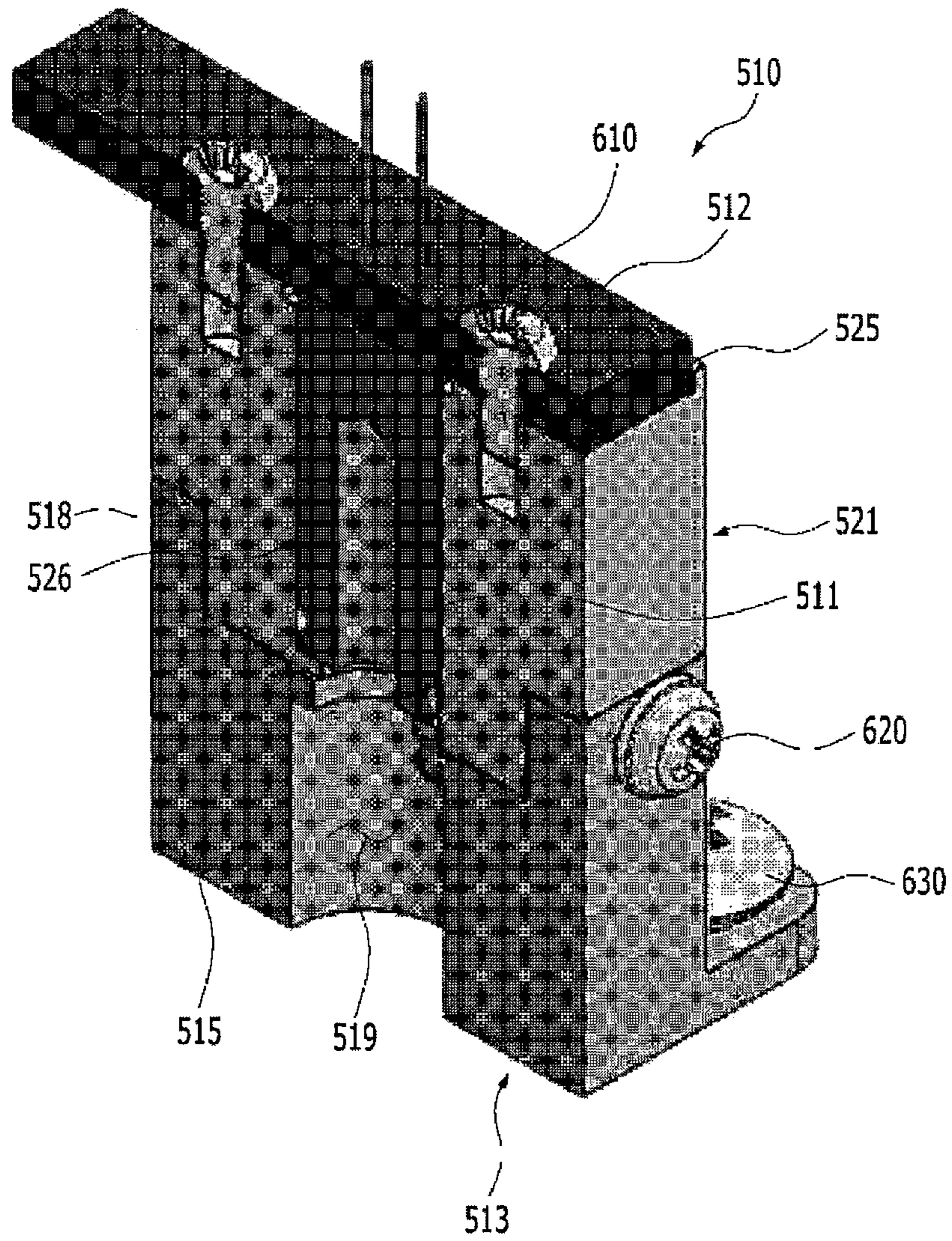
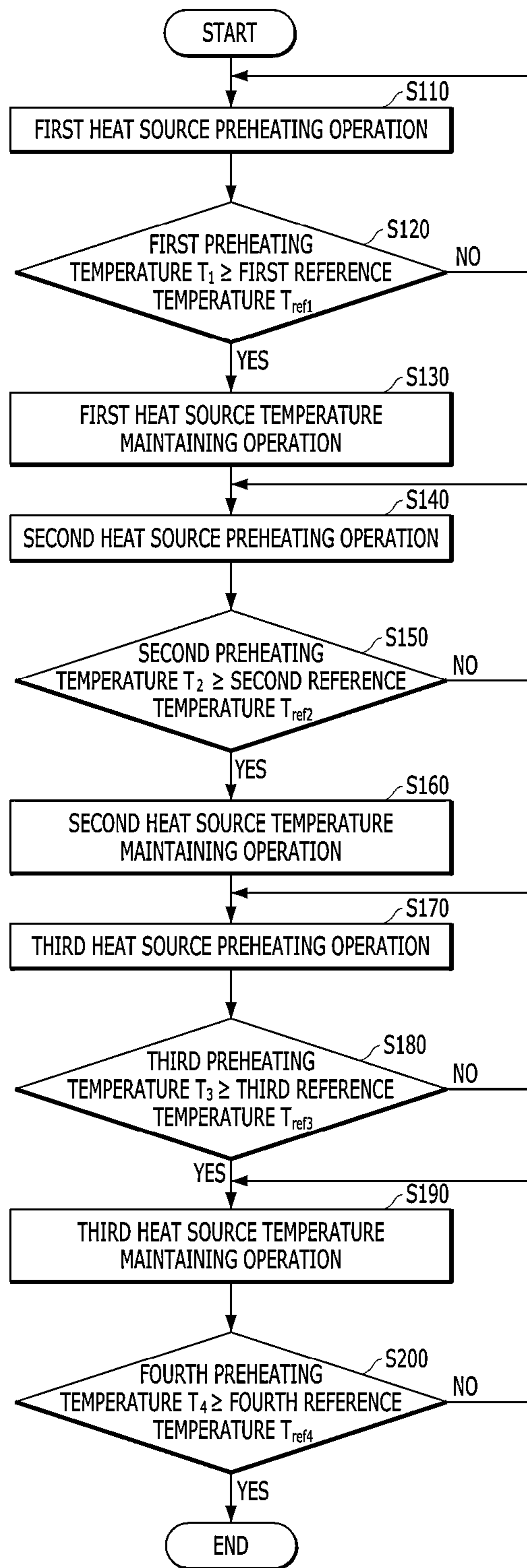


FIG. 10



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ROASTING APPARATUS AND CONTROLLING METHOD THEREOF

TECHNICAL FIELD

The present disclosure relates to a roasting apparatus and a method of controlling the roasting apparatus, and more particularly, to a roasting apparatus for roasting objects while stirring the objects in a roasting chamber, and a method of controlling the roasting apparatus.

BACKGROUND ART

Recently, there have been introduced grain roasters or coffee roasters that may easily and automatically roast grains such as coffee beans in a professional coffee shop or at home.

Such a coffee roaster automatically roasts coffee beans in a roasting operation mode set by using a temperature sensor and a microcomputer.

An automatic coffee roaster for business use in the related art mainly has a horizontally rotating drum and rotates the drum forward and backward to stir coffee beans so that the coffee beans are evenly roasted well (Korean Patent Nos. 342091, 369539, 463341, 804106, 887985, and 963695, and Korean Patent Application Laid-Open Nos. 2009-30655 and 2010-38802).

However, because the automatic coffee roaster in the related art heats the horizontally rotating drum by using only a single heat source such as direct gas combustion, there is a problem in that a large amount of time is required for preheating and it is impossible to cope with various roasting environments.

DISCLOSURE

Technical Problem

An object of the present disclosure is to provide a roasting apparatus and a method of controlling the same, which reduce a preheating operation time for roasting, thereby further improving productivity.

Another object of the present disclosure is to provide a roasting apparatus and a method of controlling the same, which more effectively measure a process of roasting objects, thereby performing roasting desired by a user.

Technical Solution

One aspect of the present disclosure provides a roasting apparatus for heating objects, the roasting apparatus including: a roasting chamber part which includes: a cylindrical roasting chamber that extends in a vertical direction and has an internal space in which the objects are stirred; and a rotary stirring part that rotates to stir the objects received in the roasting chamber and rotates about a stirring axis defined in the vertical direction; and heat source parts which supply heat to the roasting chamber part and include: a first heat source part that provides convection heat to an interior of the roasting chamber by providing hot air flow to the roasting chamber; a second heat source part that is in contact with a surface of the roasting chamber and provides conduction heat to the roasting chamber in a conduction manner; and a third heat source part that provides radiant heat to the interior of the roasting chamber.

The second heat source part may include a second heat source part body which surrounds an outer circumferential

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surface of the roasting chamber in a state in which the second heat source part body is in contact with the outer circumferential surface of the roasting chamber, and the second heat source part body may be made of a ceramic material.

The roasting chamber may have at least one roasting chamber side through hole which communicates with the outside, and the second heat source part body may have a second heat source part body side through hole which is formed at a position corresponding to the roasting chamber side through hole.

The roasting apparatus may further include a conduction temperature measurement unit which measures a temperature of the second heat source part, in which a conduction temperature measurement probe of the conduction temperature measurement unit may be in contact with both an inner surface of a third heat source part body and the outer circumferential surface of the roasting chamber in a state in which the conduction temperature measurement probe is disposed between the second heat source part and the roasting chamber, and in which the conduction temperature measurement probe of the conduction temperature measurement unit may be disposed at a position most distant from the roasting chamber side through hole and the second heat source part body side through hole.

The roasting apparatus may further include a radiant temperature measurement unit which measures temperatures of the objects received in the internal space of the roasting chamber, in which the radiant temperature measurement unit may be directed toward the internal space of the roasting chamber and disposed on an upper unit disposed at an upper side of the roasting chamber.

The upper unit may include an upper unit body having a circular shape, the upper unit body may have a measurement hole which penetrates the upper unit body in the vertical direction, the radiant temperature measurement unit may include: a sensing part which measures a temperature; and a filter part which is disposed in front of the sensing part and transmits light in a predetermined wavelength band, and the sensing part and the filter part may be aligned with the measurement hole.

The radiant temperature measurement unit may include: a first bracket which is fixed to the upper unit body and has a first through hole formed therein; a second bracket which has one side being in contact with and fixed to the first bracket, and a second through hole that is formed therein and aligned with the first through hole and into which the sensing part is fitted; and a board which is fixed to the other side of the second bracket and on which the sensing part is mounted, the first through hole and the second through hole may be aligned with the measurement hole, and the filter part may be installed between the first bracket and the second bracket.

The first bracket may include: a first bracket body which defines an external shape of the first bracket and has the first through hole disposed at a center thereof; and a pair of protruding portions which protrude upward from one side of the first bracket body, a recessed space may be provided between the protruding portions, the second bracket may include: a second bracket body which defines an external shape of the second bracket and has the second through hole disposed at a center thereof; and an insertion portion which is formed at one side of the second bracket body and fitted into the recessed space of the first bracket, and the filter part may be in close contact between the recessed space of the first bracket and the insertion portion of the second bracket

in a state in which the filter part is aligned with the first through hole disposed in the recessed space.

An elastic member may be disposed in at least one of an area between the filter part and the first bracket and an area between the filter part and the second bracket.

A cylindrical guide part may be provided on a lower surface of the upper unit and may protrude downward while surrounding the measurement hole, and the guide part may be aligned with the measurement hole.

The first heat source part may include: a flow tube through which air flows; and a heating unit which is disposed at one side of the flow tube and heats the flowing air, the third heat source part may include a lamp unit which emits the radiant heat, the upper unit may include: a first heat source arrangement hole to which the heating unit is fixed and through which heated air flows to the internal space of the roasting chamber; and a third heat source arrangement hole to which the lamp unit is fixed and through which the radiant heat emitted from the lamp unit is transferred to the internal space of the roasting chamber, the pair of lamp units and the pair of third heat source arrangement holes may be provided, and the first heat source arrangement hole may be disposed between the pair of third heat source arrangement holes.

The first heat source arrangement hole may have a circular shape, and the third heat source arrangement hole may have a rectangular shape.

The first heat source part, the second heat source part, and the third heat source part may be sequentially activated so that the first heat source part provides the convection heat to an internal space of the roasting chamber first, the second heat source part provides the conduction heat to the internal space of the roasting chamber, and then the third heat source part provides the radiant heat to the internal space of the roasting chamber, during a preheating process of raising a temperature of the internal space of the roasting chamber from room temperature to a predetermined temperature.

Another aspect according to the present disclosure provides a method of controlling a roasting apparatus including: a roasting chamber part which includes: a cylindrical roasting chamber that extends in a vertical direction and has an internal space in which the objects are stirred; and a rotary stirring part that rotates to stir the objects received in the roasting chamber and rotates about a stirring axis defined in the vertical direction; and heat source parts which supply heat to the roasting chamber part and include: a first heat source part that provides convection heat to an interior of the roasting chamber by providing hot air flow to the roasting chamber; a second heat source part that is in contact with a surface of the roasting chamber and provides conduction heat to the roasting chamber in a conduction manner; and a third heat source part that provides radiant heat to the interior of the roasting chamber, the method including: a first heat source preheating operation step of providing, by the first heat source part, the hot air flow to the internal space of the roasting chamber; a second heat source preheating operation step of providing, by the second heat source part, the conduction heat to the internal space of the roasting chamber when a measured first preheating temperature is equal to or higher than a first reference temperature in the first heat source preheating operation step; and a third heat source preheating operation step of providing, by the third heat source part, the radiant heat to the internal space of the roasting chamber when a measured second preheating temperature is equal to or higher than a second reference temperature in the second heat source preheating operation step.

The method may further include at least one of: a first heat source temperature maintaining operation step of providing, by the first heat source part, the convection heat so that the first preheating temperature is maintained as the first reference temperature, when the measured first preheating temperature is equal to or higher than the first reference temperature in the first heat source preheating operation step; a second heat source temperature maintaining operation step of providing, by the second heat source part, the conduction heat so that the second preheating temperature is maintained as the second reference temperature, when the measured second preheating temperature is equal to or higher than the second reference temperature in the second heat source preheating operation step; and a third heat source temperature maintaining operation step of providing, by the third heat source part, the radiant heat so that a third preheating temperature is maintained as a third reference temperature, when the measured third preheating temperature is equal to or higher than the third reference temperature in the third heat source preheating operation step.

The preheating operation may be ended when a fourth preheating temperature, which is a temperature measured outside the roasting chamber, is raised to a fourth reference temperature in the third heat source temperature maintaining operation step.

The roasting apparatus may further include: a convection temperature measurement unit which is disposed in a flow path of the hot air flow supplied to the roasting chamber by the first heat source part, and measures a convection temperature of the hot air flow; a conduction temperature measurement unit which has a conduction temperature measurement probe disposed between the second heat source part and an outer circumferential surface of the roasting chamber and measures a conduction temperature of the second heat source part; and a radiant temperature measurement unit which measures a radiant temperature of the internal space of the roasting chamber, and the convection temperature of the hot air flow, the conduction temperature, temperatures of the objects, and an internal temperature of the roasting chamber may be the first preheating temperature, the second preheating temperature, and the third preheating temperature, respectively.

The first preheating temperature, the second preheating temperature, and the third preheating temperature may be measured at different positions.

Advantageous Effects

According to the proposed embodiment, it is possible to provide the roasting apparatus and the method of controlling the same, which reduce a preheating operation time for roasting, thereby further improving productivity.

The roasting apparatus and the method of controlling the same may more effectively measure the process of roasting objects, thereby performing roasting desired by the user.

DESCRIPTION OF DRAWINGS

FIG. 1 is a view illustrating a roasting apparatus according to an embodiment of the present disclosure.

FIG. 2 is a view illustrating a state in which an internal configuration of the roasting apparatus illustrated in FIG. 1 is projected.

FIG. 3 is a view illustrating a configuration of a roasting chamber part of the roasting apparatus illustrated in FIG. 1.

FIG. 4 is a view illustrating the roasting chamber part illustrated in FIG. 3 when viewed from above.

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FIG. 5 is a view illustrating a state in which a third heat source part is removed from the roasting chamber part illustrated in FIG. 3.

FIG. 6 is a view illustrating an upper unit of the roasting chamber part illustrated in FIG. 3.

FIG. 7 is a view illustrating a cross section of the roasting chamber part illustrated in FIG. 3.

FIG. 8 is a view illustrating a state in which a first temperature detection unit of the roasting apparatus illustrated in FIG. 1 is disassembled.

FIG. 9 is a view illustrating a cross section of the first temperature detection unit illustrated in FIG. 8.

FIG. 10 is a view illustrating a method of controlling the roasting apparatus illustrated in FIG. 1.

BEST MODE

Advantages and features of the present disclosure and methods of achieving the advantages and features will be clear with reference to exemplary embodiments described in detail below together with the accompanying drawings. However, the present disclosure is not limited to the exemplary embodiments disclosed herein but will be implemented in various forms. The exemplary embodiments of the present disclosure are provided so that the present disclosure is completely disclosed, and a person with ordinary skill in the art to which the present disclosure pertains can fully understand the scope of the present disclosure. The present disclosure will be defined only by the scope of the appended claims.

Terms “first”, “second”, and the like may be used to describe various constituent elements, but the constituent elements are of course not limited by these terms. These terms are merely used to distinguish one constituent element from another constituent element. Therefore, the first constituent element mentioned hereinafter may of course be the second constituent element within the technical spirit of the present disclosure.

Throughout the specification, the same reference numerals denote the same constituent elements.

Respective features of several exemplary embodiments of the present disclosure may be partially or entirely coupled to or combined with each other, and as sufficiently appreciated by those skilled in the art, various technical cooperation and operations may be made, and the respective exemplary embodiments may be carried out independently of each other or carried out together correlatively.

Potential effects, which may be expected by technical features of the present disclosure that are not specifically mentioned in the specification of the present disclosure, are treated as being described in the present specification, and the present embodiments are provided to more completely explain the present disclosure to those skilled in the art. Therefore, the contents illustrated in the drawings may be exaggeratingly expressed in comparison with actual implementation of the present disclosure, and a detailed description of a configuration will be summarized or omitted when it is determined that the description may unnecessarily obscure the subject matter of the present disclosure.

Hereinafter, the embodiments of the present disclosure will be described in detail with reference to the accompanying drawings.

FIG. 1 is a view illustrating a roasting apparatus according to an embodiment of the present disclosure, and FIG. 2 is a view illustrating a state in which an internal configuration of the roasting apparatus illustrated in FIG. 1 is projected. FIG. 3 is a view illustrating a configuration of a roasting chamber

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part of the roasting apparatus illustrated in FIG. 1, and FIG. 4 is a view illustrating the roasting chamber part illustrated in FIG. 3 when viewed from above. FIG. 5 is a view illustrating a state in which a third heat source part is removed from the roasting chamber part illustrated in FIG. 3. FIG. 6 is a view illustrating an upper unit of the roasting chamber part illustrated in FIG. 3, and FIG. 7 is a view illustrating a cross section of the roasting chamber part illustrated in FIG. 3. FIG. 2 illustrates a state in which a casing 190 is rendered in a semi-transparent manner and an internal configuration of a roasting apparatus 1 is projected outward in a state in which the casing 190 is installed which defines an external shape of the roasting apparatus 1.

Referring to FIGS. 1 to 7, the roasting apparatus 1 according to the embodiment of the present disclosure refers to an apparatus for roasting objects such as coffee beans by heating the objects. The roasting apparatus 1 includes a roasting chamber part 100 in which the objects are received and roasted, a control panel part 200 which displays information about a roasting situation of the objects and receives an operating signal from a user, an object storage part 400 which stores the objects completely roasted in the roasting chamber part 100, and heat source parts 310, 320, and 330 which supply heat to the roasting chamber part 100. The roasting chamber part 100 is surrounded by the casing 190 made of metal.

In more detail, the roasting chamber part 100 includes a cylindrical roasting chamber 120 which extend in a vertical direction and has an internal space 121 in which the objects are stirred, a rotary stirring part 180 which includes stirring blade units 181 that rotates to stir the objects received in the roasting chamber 120, an upper unit 110 that has a circular shape and is disposed at an upper side of the roasting chamber 120, a lower unit 130 that has a circular shape and is disposed at a lower side of the roasting chamber 120, and a discharge unit 150 which communicates with the internal space 121 of the roasting chamber 120 and is selectively opened to discharge, to the outside, the objects completely roasted in the internal space 121 of the roasting chamber 120.

The roasting chamber 120 may be formed in a cylindrical shape extending in the vertical direction, and a stationary blade 122 may be formed on an inner surface of the roasting chamber 120 so as to stir the objects more smoothly. The stationary blade 122 protrudes from the inner surface of the roasting chamber 120, and the stationary blade 122 is shaped such that a protruding height of the stationary blade 122 is increased from the lower side to the upper side of the roasting chamber 120.

The discharge unit 150 may include a door portion (not illustrated) which is opened or closed based on an operating signal of a control unit (not illustrated), and a lever portion (not illustrated) which is used by a user to forcibly open the door portion in an emergency situation, regardless of a control signal of the control unit. The discharge unit 150 extends to be inclined toward the object storage part 400, such that when the door portion of the discharge unit 150 is opened, the roasted objects may be supplied to the object storage part 400.

Further, the stirring blade units 181 of the rotary stirring part 180 are rotated about a stirring axis defined in the vertical direction. Therefore, in the state in which the roasting chamber part 100 according to the present embodiment extends in the vertical direction, the stirring blade units 181 of the rotary stirring part 180 are rotated about the stirring axis defined in the vertical direction to stir the

objects. This is advantageous in that the objects may be more efficiently roasted and the roasting apparatus **1** may be more efficiently disposed.

The heat source parts **310**, **320**, and **330** include a first heat source part **310** which provides convection heat to an interior of the roasting chamber **120** by providing a hot air flow to the roasting chamber **120**, a second heat source part **330** which is in contact with a surface of the roasting chamber **120** and provides conduction heat to the roasting chamber **120** in a conduction manner, and a third heat source part **320** which provides radiant heat to the interior of the roasting chamber **120**.

The first heat source part **310** includes a flow tube **311** through which air flows, and a heating unit **312** which is disposed at one side of the flow tube **311** and heats the flowing air. The flow tube **311** is connected to a blow unit **313** for supplying air and is supplied with the air, and one side of the heating unit **312** and one side of the flow tube **311** are connected to the upper unit **110**. For example, the heating unit **312** has a plurality of heating elements which are disposed in the form of a mesh or a coil, and the air is heated while passing through the heating elements.

The second heat source part **330** includes a second heat source part body which surround an outer circumferential surface of the roasting chamber **120** in a state in which the second heat source part body is in contact with the outer circumferential surface of the roasting chamber **120**. The second heat source part body may be a band heater made of a ceramic material.

Meanwhile, the roasting chamber **120** has at least one roasting chamber side through hole which communicates with the outside, and the second heat source part body has a second heat source part body side through hole which is formed at a position corresponding to the roasting chamber side through hole.

For example, the roasting apparatus **1** further includes a sample collection unit **161** which collects a sample during a roasting process, and a window unit **162** which enables the user to visually check the roasting process in the roasting chamber **120**. The sample collection unit **161** and the window unit **162** are installed in the roasting chamber side through holes and the second heat source part body side through holes. An air discharge port **163** is formed at the upper side of the roasting chamber **120** and communicates with the internal space of the roasting chamber **120**. The second heat source part **330** is not disposed in an area of the air discharge port **163**. That is, the second heat source part **330** is installed only up to a predetermined height from the outer circumferential surface of the roasting chamber **120**, and an object receiving limit line of the internal space **121** of the roasting chamber **120**, in which the objects are received, may be defined to the height at which the second heat source part **320** is installed.

Dust (bean pods and the like), which generated from the objects during the roasting process, is delivered to a dust collection unit **600** through the air discharge port **163**. The dust collection unit **600** discharges the air to the outside, and stores the dust in a dust storage (not illustrated) therein.

The third heat source part **320** may include a lamp unit **321** which emits radiant heat and is installed on the upper unit **110** and provides the radiant heat to the internal space **121** of the roasting chamber **120**. For example, the lamp unit **321** may be a halogen lamp.

Meanwhile, the upper unit **110** includes an upper unit body **111** having a circular shape. The upper unit body **111** has a first heat source arrangement hole **113** to which the heating unit **312** of the first heat source part **310** is fixed and

through which heated air flows to the internal space **121** of the roasting chamber **120**, a third heat source arrangement hole **114** to which the lamp unit **321** of the third heat source part **320** is fixed and through which the radiant heat emitted from the lamp unit **321** is transferred to the internal space **121** of the roasting chamber **120**, and an object supply hole **112** which is connected to a hopper unit **170** of the roasting apparatus **1** and through which the objects are inputted into the internal space **121** of the roasting chamber **120**. In addition, a diffuser part **118** is provided at a lower side of the upper unit **110**, guides the hot air flow supplied from the first heat source part **310**, and has a diameter that increases downward. The diffuser part **118** extends from a lower surface of the upper unit **110** to the rotary stirring part **180** disposed at the lower side of the roasting chamber **120**. A recessed groove (not illustrated) may be formed in the stirring blade unit **181** of the rotary stirring part **180** in order to avoid interference with the diffuser part **118**.

The pair of lamp units **321** of the third heat source part **320** and the pair of third heat source arrangement holes **114** may be provided, and the first heat source arrangement hole **113** is provided between the pair of third heat source arrangement holes **114**. The first heat source arrangement hole **113** disposed at a center of the upper unit body **111** has a circular shape, and the third heat source arrangement hole **114** has a rectangular shape. Meanwhile, a third heat source guide unit **119** is provided on the upper unit body **111** according to the present embodiment, surrounds the third heat source arrangement hole **114** and extends downward. The third heat source guide unit **119** has a rectangular cross-section shape corresponding to the third heat source arrangement hole **114**. The third heat source guide unit **119** may prevent a surface of the lamp unit **321** of the third heat source **320** from being contaminated by the dust generated from the objects during the roasting process in the roasting chamber **120**.

The roasting apparatus **1** according to the present embodiment further includes measurement units **510**, **520**, and **530** which measure heat source supply temperatures of the heat source parts **310**, **320**, and **330** that supply heat to the roasting chamber **120**.

A radiant temperature measurement unit **510** measures radiant temperatures of the objects received in the internal space **121** of the roasting chamber **120**. The radiant temperature measurement unit **510** is directed toward the internal space **121** of the roasting chamber **120** and disposed on the upper unit **110** disposed at the upper side of the roasting chamber **120**. In this case, the upper unit body **111** has a measurement hole **115** which penetrates the upper unit body **111** in the vertical direction. The measurement hole **115** is positioned at an eccentric position from the center of the upper unit body **111**. The radiant temperature measurement unit **510** according to the present embodiment measures a change in temperature of the objects by detecting infrared rays, emitted from surfaces of the objects, during the roasting process. Therefore, the roasting apparatus **1** according to the embodiment of the present disclosure may advantageously accurately detect the temperatures of the objects and accurately perform the roasting desired by the user in comparison with a roasting apparatus in the related art which detects only a change in temperature in the roasting chamber **120**. During a process of performing a preheating operation of preheating the roasting chamber **120** before inputting the objects into the roasting chamber **120**, the radiant temperature measurement unit **510** may detect a temperature of a surface of the lower unit **130** which defines a bottom surface of the roasting chamber **120**.

As described below, a plurality of experiments was performed on installation positions of the radiant temperature measurement unit **510** according to the present embodiment. In the present embodiment, the radiant temperature measurement unit **510** was installed at an optimum installation position directed toward the lower side from the upper unit **110**, that is, directed toward the internal space **121** of the roasting chamber **120** from the upper unit **110**.

TABLE 1

Installation Positions	Scratch of filter	Thermal damage to filter	Measurement Accuracy
Upper portion of roasting chamber	X	X	High
Central portion of roasting chamber	○	X	High
Lower portion of roasting chamber	○	○	Low

Hereinafter, the radiant temperature measurement unit **510** according to the present embodiment will be described in more detail.

FIG. **8** is a view illustrating a state in which a first temperature detection unit of the roasting apparatus illustrated in FIG. **1** is disassembled, and FIG. **9** is a view illustrating a cross section of the first temperature detection unit illustrated in FIG. **8**.

Referring to FIGS. **8** and **9**, the radiant temperature measurement unit **510** includes a sensing part **511** which measures a temperature, a filter part **514** which is disposed in front of the sensing part **511** and transmits light in a predetermined wavelength band, a first bracket **513** which is fixed to the upper unit body **111** of the roasting chamber part **100** and has a first through hole **519** formed therein, a second bracket **521** which has one side being in contact with and fixed to the first bracket **513** and a second through hole **526** that is formed therein and aligned with the first through hole **519** and into which the sensing part **511** is fitted, and a board **512** which is fixed to the other side of the second bracket **521** and on which a sensing part **511** is mounted.

In this case, the sensing part **511**, the first through hole **519**, the second through hole **526**, and the filter part **514** are aligned with the measurement hole **115** of the upper unit **110**, and the filter part **514** is installed between the first bracket **513** and the second bracket **521**.

The sensing part **511** has a cylindrical shape and senses infrared rays emitted from the objects. The sensing part **511** extends in a direction identical to the penetration direction of the measurement hole **115**. For example, the sensing part **511** may be an IR sensor.

For example, the filter part **514** may be made of a material, such as glass or silicone, which is transparent and less deformed by heat. The filter part **514** transmits only the light beams in an infrared band among the light beams transmitted to the sensing part **511** from the roasting chamber **120**.

The first bracket **513** includes a first bracket body **515** which defines an external shape of the first bracket **513** and has the first through hole **519** disposed at a center thereof, and a pair of protruding portions **518** which protrude upward from one side of the first bracket body **515**. A recessed space **517** is provided between the protruding portions **518**, and a pair of first bracket fixing portion **516** protrudes from a lower side of the first bracket body **515** and is penetrated by first fastening members **630** fastened to the upper unit body **111**.

The second bracket **521** includes a second bracket body **522** which defines an external shape of the second bracket **521**, an insertion portion **523** which is formed at one side of the second bracket body **522** and fitted into the recessed space of the first bracket **513**, a board seating surface **524** which is disposed on an upper surface of the second bracket **521** and on which the board **512** is seated, and a pair of board fixing protrusions **525** which protrude upward from a rim of the board seating surface **524** and by which one side and the other side of the board **512** are caught.

In a state in which the filter part **514** is aligned with the first through hole **519** disposed in the recessed space **517**, the filter part **514** is in close contact between the recessed space **517** of the first bracket **513** and the insertion portion **523** of the second bracket **521**. In a state in which the insertion portion **523** of the second bracket **521** is inserted into the recessed space **517** of the first bracket **513**, the first bracket **513** and the second bracket **521** may be fixed by second fastening members **620** which integrally penetrate the protruding portions **518** of the first bracket **513** and the insertion portion **523** of the second bracket **521**. That is, in the state in which the first through hole **519** is sealed by the filter part **514**, the first bracket **513** and the second bracket **521** are securely fixed to each other with the filter part **514** interposed therebetween, and as a result, it is possible to prevent foreign substances in the internal space **121** of the roasting chamber **120** from entering the inside and the outside the radiant temperature measurement unit **510** through the first through hole **519** which communicates with the measurement hole **115** of the roasting chamber **120**. Meanwhile, an elastic member (not illustrated) made of rubber or silicone may be disposed in at least one of an area between the filter part **514** and the first bracket **513** and an area between the filter part **514** and the second bracket **521** and securely seal the space and inhibit damage to the filter part **514**.

The sensing part **511** is fitted into the second through hole **526** of the second bracket **521**. In a state in which the board **512** is seated on the seating surface **524**, third fastening members **610** may be fixed to fastening holes **527** of the second bracket **521** through the board **512** and securely fix the board **512** and the second bracket **521**.

The board **512** may be a PCB having a plate shape. A roasting chamber outside temperature measurement element (not illustrated) may be provided on the board **512** and measure an outside temperature of the roasting chamber **120** at a position at which the board **512** is installed, that is, an outside temperature of a portion adjacent to the roasting chamber **120**. That is, the radiant temperature measurement unit **510** according to the present embodiment may measure the radiant temperature of the internal space **121** of the roasting chamber **120** and the temperature of the external space of the roasting chamber **120**.

Further, a cylindrical guide part **116** is provided on the lower surface of the upper unit **110** and protrudes downward while surrounding the measurement hole **115**, and the guide part **116** is aligned with the measurement hole **115**. That is, since the guide part **116** surrounds the measurement hole **115** and protrudes to the internal space **121** of the roasting chamber **120**, it is possible to prevent the dust, which is generated in the internal space **121** of the roasting chamber **120** during the roasting process, from entering the measurement hole **115** and contaminating the surface of the filter part **514**. The sensing part **511** may emit the light for measurement to the internal space **121** of the roasting chamber **120** or receive the light emitted from the objects through the measurement hole **115** surrounded by the guide part **116**.

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Referring back to FIGS. 3 to 7, the measurement units 510, 520, 530, 540, and 550 of the roasting apparatus 1 according to the present embodiment further include a convection temperature measurement unit 530 which is disposed in a flow path of the hot air flow supplied to the roasting chamber 120 by the first heat source part 310, and measures a convection temperature of the hot air flow, a conduction temperature measurement unit 540 which has a conduction temperature measurement probe 541 disposed between the second heat source part 330 and the outer circumferential surface of the roasting chamber 120 and measures a conduction temperature of the second heat source part 330, and a contact temperature measurement unit 550 which is installed at the lower side of the roasting chamber 120, is in direct contact with the objects during the roasting process and measures the temperatures of the objects.

In this case, a convection temperature measurement probe 531 of the convection temperature measurement unit 530 penetrates a lateral portion of the roasting chamber 120 and the diffuser part 118, and a tip portion of the convection temperature measurement probe 531 may be positioned at a downstream side of the heating unit 312 and measure the temperature of the hot air flow passing through the heating unit 312.

In a state in which the conduction temperature measurement probe 541 of the conduction temperature measurement unit 540 is disposed between the second heat source part 330 and the roasting chamber 120, the conduction temperature measurement probe 541 of the conduction temperature measurement unit 540 is in contact with both an inner surface of the second heat source part body 331 and the outer circumferential surface of the roasting chamber 120. In this case, the conduction temperature measurement probe 541 of the conduction temperature measurement unit 540 is disposed at a position most distant from the roasting chamber side through hole and the second heat source part body side through hole. That is, the roasting chamber side through hole and the second heat source part body side through hole communicate with the outside, and the heating element of the second heat source part 330 is not disposed at the corresponding position, such that the measured temperature is relatively high at the position most distant from the roasting chamber side through hole and the second heat source part body side through hole. Therefore, the conduction temperature measurement probe 541 of the conduction temperature measurement unit 540 is disposed at the position most distant from the roasting chamber side through hole and the second heat source part body side through hole, such that the conduction temperature measurement probe 541 measures the conduction temperature based on the highest temperature.

Hereinafter, a method of controlling the roasting apparatus according to the present embodiment, particularly, a method of controlling a preheating operation will be described in detail.

FIG. 10 is a view illustrating a method of controlling the roasting apparatus illustrated in FIG. 1.

Referring to FIG. 10, before the objects are inputted into the roasting apparatus 1 according to the present embodiment and the objects are roasted, a preheating operation is performed to raise a temperature of the internal space 121 of the roasting chamber 120 to a preheating temperature at a desired level. The roasting apparatus 1 according to the present embodiment may complexly use the three heat sources to perform the preheating operation, thereby more quickly raising the temperature of the internal space 121 to

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a desired preheating temperature. After the preheating operation is ended, the roasting apparatus 1 according to the present embodiment may differently control the three heat sources depending on the user's preference, thereby performing roasting to implement flavor desired by the user.

First, a first heat source preheating operation step S110 is performed, in which the first heat source part provides the hot air flow to the internal space of the roasting chamber.

Next, when a measured first preheating temperature T_1 is equal to or higher than a first reference temperature T_{ref1} (S120) in the first heat source preheating operation step S110, a first heat source temperature maintaining operation step S130 is performed, in which the first heat source part 310 provides the convection heat so that the first preheating temperature T_1 is maintained as the first reference temperature T_{ref1} . In this case, the first preheating temperature T_1 according to the present embodiment may be the convection temperature of the hot air flow measured by the convection temperature measurement unit 530, and in the first heat source temperature maintaining operation step S130, electric power, at a level lower than the first heat source preheating operation step S110, is supplied to the first heat source part 310.

Further, when the measured first preheating temperature T_1 is lower than the first reference temperature T_{ref1} S120, the first heat source preheating operation step S110 is repeatedly performed.

Next, a second heat source preheating operation step S130 is performed, in which the second heat source part 330 provides the conduction heat to the internal space 121 of the roasting chamber 120.

When a measured second preheating temperature T_2 is equal to or higher than a second reference temperature T_{ref2} (S150) in the second heat source preheating operation step S130, a second heat source temperature maintaining operation step S160 is performed (S160), in which the second heat source part 330 provides the conduction heat so that the second preheating temperature T_2 is maintained as the second reference temperature T_{ref2} . In this case, the second preheating temperature T_2 according to the present embodiment may be the conduction temperature of the second heat source part 330 measured by the conduction temperature measurement unit 540, and in the second heat source temperature maintaining operation step S160, electric power, at a level lower than the second heat source preheating operation step S140, is supplied to the second heat source part 330.

When the measured second preheating temperature T_2 is lower than the second reference temperature T_{ref2} (S150), the second heat source preheating operation step S140 is repeatedly performed.

Next, a third heat source preheating operation step S170 is performed, in which the third heat source part 320 provides the radiant heat to the internal space 121 of the roasting chamber 120.

When a measured third preheating temperature T_3 is equal to or higher than a third reference temperature T_{ref3} (S190) in the third heat source preheating operation step S170, a third heat source temperature maintaining operation step S190 is performed, in which the third heat source part 320 provides the radiant heat so that the third preheating temperature T_3 is maintained as the third reference temperature T_{ref3} . In this case, the third preheating temperature T_3 according to the present embodiment may be the radiant temperature of the internal space 121 of the roasting chamber 120 measured by the radiant temperature measurement unit 510, and in the third heat source temperature maintain-

ing operation step S190, electric power, at a level lower than the third heat source preheating operation step S170, is supplied to the third heat source part 320.

Further, when the measured third preheating temperature T_3 is lower than the third reference temperature T_{ref3} (S180), the third heat source preheating operation step S170 is repeatedly performed.

Next, when a fourth preheating temperature T_4 , which is a temperature measured outside the roasting chamber 120, is raised to a fourth reference temperature T_{ref4} (S200), the preheating operation is ended.

Further, when the measured fourth preheating temperature T_4 is lower than the fourth reference temperature T_{ref4} (S200), the third heat source temperature maintaining operation S190 is repeatedly performed. In this case, the first heat source temperature maintaining operation step S130 and the second heat source temperature maintaining operation step S160 are also continuously performed.

That is, the first preheating temperature T_1 , the second preheating temperature T_2 , the third preheating temperature T_3 , and the fourth preheating temperature T_4 according to the present embodiment are measured at different positions. The first preheating temperature T_1 , the second preheating temperature T_2 , and the third preheating temperature T_3 are the convection temperature, the conduction temperature, and the radiant temperature of the heat transferred from the first heat source part 310, the second heat source part 330, and the third heat source part 320. The fourth preheating temperature T_4 is the temperature of the external space adjacent to the roasting chamber 120, that is, a temperature by which the temperature of the internal space 121 of the roasting chamber 120 may be estimated.

According to the proposed embodiment, it is possible to provide the roasting apparatus and the method of controlling the same, which reduce a preheating operation time for roasting, thereby further improving productivity.

The roasting apparatus and the method of controlling the same may more effectively measure the process of roasting objects, thereby performing roasting desired by the user.

While the exemplary embodiments of the present disclosure have been described above, the present disclosure is not limited thereto, and various modifications can be made and carried out within the scope of the claims, the detailed description of the invention, and the accompanying drawings, and also fall within the scope of the present disclosure.

MODE FOR INVENTION

Modes for carrying out the invention have been described in the best mode for carrying out the invention.

INDUSTRIAL APPLICABILITY

The embodiments according to the present disclosure relate to the roasting apparatus and the method of controlling the same and are repeatable and industrially applicable in respect to the roasting apparatus for roasting objects such as coffee beans or grains.

What is claimed is:

1. A roasting apparatus comprising:

a roasting chamber comprising a cylindrical wall defining an internal roasting space in which objects are to be roasted;

a hopper connected to the roasting chamber and configured to supply the objects to the roasting chamber;

a first heat source configured to supply a hot airflow to the internal roasting space of the roasting chamber,

wherein the first heat source comprises an airflow mechanism for generating an airflow and a first heater for heating air being flown toward the internal roasting space;

a second heat source configured to heat the cylindrical wall of the roasting chamber, wherein the second heat source comprises a second heater that surrounds and is in contact with an exterior circumference of the cylindrical wall; and

a housing enclosing the roasting chamber and defining an external space that is outside the cylindrical wall of the roasting chamber,

wherein the roasting apparatus is configured to perform a preheating process prior to initiating roasting of objects in the internal roasting space,

wherein the preheating process is configured to heat the internal roasting space with the hot airflow by the first heat source and a conductive heat transfer from the second heat source to the cylindrical wall of the roasting chamber,

wherein in addition to heating the internal roasting space, the preheating process is configured to heat the external space outside the cylindrical wall by the second heater that surrounds the exterior circumference of the cylindrical wall.

2. The roasting apparatus of claim 1, wherein the roasting apparatus is configured to detect temperature in the external space and further configured to control the preheating process using the detected temperature in the exterior space.

3. The roasting apparatus of claim 2, further comprising a radiant temperature sensor that is configured to detect radiant temperature in the external space.

4. The roasting apparatus of claim 1, further comprising a radiant temperature measurement unit comprising an infrared-pass filter and a radiant temperature sensor, wherein the infrared-pass filter is configured to pass infrared rays emitted from objects being roasted in the internal roasting space, wherein the radiant temperature sensor is configured to detect the infrared rays that have passed the infrared-pass filter.

5. The roasting apparatus of claim 4, wherein the radiant temperature measurement unit further comprises a cylindrical guide aligned with the infrared-pass filter and extending toward the internal roasting space from above, wherein the cylindrical guide is configured to reduce dust in the internal roasting space from contaminating the infrared-pass filter.

6. The roasting apparatus of claim 4, wherein the radiant temperature measurement unit provides changes in temperature of the objects being roasted in the internal roasting space.

7. The roasting apparatus of claim 1, further comprising a radiant temperature sensor configured to detect radiant temperature of objects being roasted in the internal roasting space.

8. The roasting apparatus of claim 7, wherein in addition to detect radiant temperature of the objects being roasted in the internal roasting space, the radiant temperature sensor is further configured to detect radiant temperature in the external space that is outside the cylindrical wall of the roasting chamber.

9. The roasting apparatus of claim 1, wherein the second heater comprises a ceramic band heater.

10. The roasting apparatus of claim 1, further comprising a third heat source configured to provide radiant heat into the internal roasting space, wherein the third heat source comprising a third heater installed above the internal roasting space of the roasting chamber.

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11. The roasting apparatus of claim 1, further comprising a convection temperature sensor configured to detect temperature of the hot airflow downstream the first heater.

12. The roasting apparatus of claim 1, further comprising a conduction temperature sensor configured to detect temperature of the cylindrical wall of the roasting chamber.

13. The roasting apparatus of claim 12, wherein the conduction temperature sensor is interposed between the second heater and the cylindrical wall of the roasting chamber.

14. The roasting apparatus of claim 1, wherein in performing the preheating process, the roasting apparatus is configured to run the first heat source and to subsequently run the second heat source.

15. The roasting apparatus of claim 1, further comprising a convection temperature sensor configured to detect convection temperature of the hot airflow downstream the first heater,

wherein in performing the preheating process, the roasting apparatus is configured to run the first heat source and to subsequently initiate running the second heat source when the convection temperature detected by the convection temperature sensor is equal to or higher than a predetermined convection temperature.

16. The roasting apparatus of claim 1, further comprising a third heat source configured to provide radiant heat into the internal roasting space and a conduction temperature sensor configured to detect conduction temperature of the cylindrical wall of the roasting chamber

wherein in performing the preheating process, the roasting apparatus is configured to run the second heat source and to subsequently initiate running the third heat source when the conduction temperature detected by the conduction temperature sensor is equal to or higher than a predetermined conduction temperature.

17. The roasting apparatus of claim 1, further comprising a third heat source configured to provide radiant heat into the internal roasting space and a radiant temperature sensor configured to detect radiant temperature inside the internal roasting space, wherein in performing the preheating process, the roasting apparatus is configured to maintain running the third heat source when the radiant temperature

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detected by the radiant temperature sensor reaches a predetermined radiant temperature.

18. The roasting apparatus of claim 1, wherein the roasting apparatus is configured to detect temperature in the external space, wherein the roasting apparatus is configured to complete the preheating process when the temperature detected in the external space is equal to or higher than a predetermined temperature.

19. The roasting apparatus of claim 1, further comprising:
 a third heat source configured to provide radiant heat into the internal roasting space;
 a convection temperature sensor configured to detect convection temperature of the hot airflow downstream the first heater;
 a conduction temperature sensor configured to detect conduction temperature of the cylindrical wall of the roasting chamber; and
 a radiant temperature sensor configured to detect radiant temperature inside the internal roasting space,
 wherein in performing the preheating process, the roasting apparatus is configured to run the first heat source, the second heat source, and the third heat source sequentially such that
 the first heat source is run first,
 running of the second heat source is initiated when the convection temperature is at or higher than a predetermined convection temperature, and
 running the third heat source is initiated when the conduction temperature is at or higher than a predetermined conduction temperature.

20. The roasting apparatus of claim 1, further comprising a third heat source configured to provide radiant heat into the internal roasting space,
 wherein in performing the preheating process, the roasting apparatus is configured to run the first, second and third heat sources sequentially such that the first heat source is run to maintain a first target temperature when initiating to run the second heat source and further such that the second heat source is run to maintain a second target temperature when initiating to run the third heat source.

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